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Explosives Division.



**Canada**

**Department of Mines  
(and Technical Surveys)**



Annual Report of the

# **EXPLOSIVES DIVISION**



**Calendar Years  
1944-51**





**Canada**

**Department of Mines  
and Technical Surveys**

**Report of the**

**EXPLOSIVES**

**DIVISION**

**Calendar Years 1944-51**

**by**


**W. P. CAMPBELL**

**Chief Inspector**



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## INTRODUCTION

This report deals with the administration of the Explosives Act during the years 1944 to 1951 inclusive. Its purpose is to supplement the brief reports of the Explosives Division which appear in the annual reports of the Department for the fiscal years 1943-44 to 1951-52. Its issue marks the resumption of the practice, discontinued since 1944, of publishing a separate annual report and the list of authorized explosives.

## OFFICES

The main office of the Explosives Division was moved from the Norlite Building, Wellington Street, Ottawa, in 1947 to the Motor Building, 238 Sparks Street. Branch offices are maintained at 300 West Pender Street, Vancouver, B.C. and at 7 Terminal Road, Halifax, N.S. The Explosives Testing Laboratory which is maintained jointly by the Department of Mines and Technical Surveys and the National Research Council is located at the National Research Council Annex, Montreal Road, Ottawa.

## STAFF

In November 1944, F. E. Leach retired on superannuation from the position of chief inspector of explosives which he held from April 1937. He joined the division in 1921 and served as inspector of explosives in Western Canada before taking up the duties of chief inspector. The period of his services as chief inspector included the busy war years and he was honoured by the award of the M.B.E. at the close of the war. In September 1950, the division lost—by retirement also—the services of M. C. Fletcher, another early member of the staff. He joined the division in 1922 and served first as chemist and later as inspector. At the outbreak of war in 1939 he took over the duties of chief explosives chemist which position he occupied until his retirement. Mr. Fletcher rendered valuable service during the war and was awarded the M.B.E. It is appropriate to refer to Mr. Douglas Sharpe, also, who from June 1942 to March 1946 was loaned to the Division by Canadian Industries Limited. Mr. Sharpe rendered meritorious service as inspector of explosives. On the retirement of F. E. Leach, W. P. Campbell was appointed chief inspector of explosives. D. A. B. Stevenson was appointed to fill the vacancy created by Mr. Fletcher's retirement, and two new inspectors of explosives, W. B. Paton and H. P. Kimbell were appointed in 1944. Mr. Paton was assigned to the Vancouver Office of the Division, which had been closed temporarily in 1941, Mr. Kimbell to headquarters in Ottawa. In January 1951 G. J. Boisjoli, was placed in charge of the recently established office of the Division at Halifax, N.S. The latter appointment was made necessary by increase of work in the Maritime Provinces and the entry of Newfoundland into Confederation. The present staff of the division consists of the chief inspector of explosives, four inspectors, the chief explosives chemist, two chemists and a clerical staff of eleven.

## LEGISLATION

The Explosives Act 1914 was proclaimed in 1920 and was not revised until 1946. With the repeal of war-time regulations in prospect, it was thought that a revision of the Act should be undertaken to bring it into line with administrative changes in the Department and present-day requirements and to remedy certain administrative difficulties. Bill "E", to revise the Explosives Act Chapter 62, R.S.C. 1927, received the approval of Parliament on May 20, 1946 and Royal Assent on May 28, 1946.

Major changes in the new Act made provision for:

- (1) The sale of explosives under the control of the Act.
- (2) The forfeiture of unauthorized explosives.
- (3) The seizure of explosives in connection with which an offence under the Act has been committed.
- (4) The destruction of abandoned or deteriorated explosives.

Possession and storage of explosives by Government employees by or on behalf of Her Majesty in the right of Canada or any province now comes within the scope of the new Act except explosives under the direction or control of the Minister of National Defence.

The Act, as revised, continued the war-time restrictions on the sale of explosives which required every vendor of high explosives to be the owner or operator of a licensed factory or a licensed magazine. Prior to July 4, 1940, when Order in Council P.C. 2903 was passed under the War Measures Act, the sale of explosives was permitted from what was then known as "unlicensed premises" provided the quantity of blasting explosives stored at any one time did not exceed 150 pounds and that the explosives were stored as prescribed by regulations under the Act.

When the revision of the Explosives Act was being considered in 1946 it was recognized that there was a fairly widespread demand for explosives by users who required only a few pounds at a time. To meet such legitimate needs the principle of licensing magazines was extended to include "registered premises" in which quantities of blasting explosives not exceeding 175 pounds could be stored for sale. Premises complying with regulations may now be registered under the Act and a certificate, renewable annually, is issued to the owner or operator.

Certain definite safety precautions must be observed in the storage of explosives in registered premises and these are set forth in Explosives Regulations Part XI. Many general merchants, hardware dealers and farmers have availed themselves of this provision of the Act. Enforcement of this provision has meant additional inspection and office work but has the distinct advantage of making known to the Explosives Division all premises from which high explosives are sold. Operators of registered premises are required by regulation to maintain records giving the name and address of all purchasers of blasting explosives and detonators. These records are open for inspection by the Division's inspectors and extend the field in which they can correct negligent storage and give safety advice to the accident-prone casual user.

Regulations made under the old Act were also revised in 1946, being approved by Order in Council, P.C. 5115, December 12, 1946 and published in a supplement to the *Canada Gazette*, December 31, 1946. In the revised regulations three new parts were added namely, Explosives Regulations Parts IV, X and XI which, respectively, control the manufacture of explosives outside factories, the sale of explosives, and the storage of explosives in registered premises. The revised regulations remove sky-rockets from the "Shop Goods" sub-division of Division 2, Class 7. They must not be sold by retailers but may be sold by a vendor who is the owner or operator of a licensed magazine, provided they are for use in fireworks displays conducted by *bona fide* organizations that will assume full responsibility for their safe use.

Order in Council, P.C. 2903, July 4, 1940 made under the War Measures Act to regulate the possession, use and sale of explosives served its purpose well. From July 4, 1940 to January 1, 1947, the period of its operation, 135,000 explosives purchase permits were issued. Members of the Royal Canadian Mounted Police, police officers of provinces and municipalities and inspectors of provincial Mines Departments gave much valued assistance in issuing permits and in enforcement.

### FACTORIES, MAGAZINES AND REGISTERED PREMISES

Licences for factories issued in 1951 numbered one-half of those issued in 1944 but licences for magazines almost doubled, as reference to the following table will show. Temporary magazines have shown the greatest increase owing to the many construction projects started during this period. In 1947, Registered Premises certificates became available to dealers whose storage requirements, at any one time, did not exceed 175 pounds of blasting explosives. The number of such premises is steadily increasing.

#### LICENCES ISSUED

Year	Factory Licences	Magazine Licences	Temporary Mag. Lic's.	Registered Premises	Total
1944	37	365	379	.....	781
1945	37	359	438	.....	834
1946	17	382	512	.....	911
1947	19	377	563	49	1,008
1948	16	391	599	53	1,059
1949	16	392	634	59	1,101
1950	17	391	690	62	1,160
1951	19	389	819	74	1,301

#### INSPECTIONS

The number of magazine inspections, greatly reduced during the war, has been on the increase since 1944. Except for those in remote districts, magazines and registered premises are inspected at least once a year. The Royal Canadian Mounted Police, who are deputy inspectors of explosives, give valuable assistance in this work, although since 1950 they have had to curtail inspections because of pressure of other work.

Substantial quantities of small arms ammunition may be kept for sale in unlicensed premises but such premises, and sales records which the vendor must keep, are subject to inspection.

#### INSPECTIONS

Year	Factories	Magazines	Registered Premises	Unlicensed Premises
1944	160	526	.....	3,156
1945	57	650	.....	4,451
1946	32	742	.....	5,795
1947	30	917	39	7,692
1948	27	1,001	73	6,908
1949	21	997	137	7,429
1950	37	1,174	67	7,445
1951	33	1,170	104	4,316

#### PLANT DECONTAMINATION COMMITTEE

Military explosives production of all kinds ceased at the close of the war and the dismantling of factories began. A committee under the chairmanship of Lieut.-Col. G. Ogilvie, C.M.G., a former chief inspector of explosives, was appointed by the Minister of Munitions and Supply to supervise the work. It was the duty of this committee to consider the condition of buildings in explosives factories and shell filling plants slated for dismantling and to indicate appropriate treatment before disposal. The chief inspector was a member of this committee and officers of the Division rendered much assistance, inspecting buildings for the committee. By the beginning of 1946, almost all explosives plants had been turned over to War Assets Corporation for disposal. The few remaining factories were retained intact on a "standby" basis against future need. It did not seem possible then that within 6 years these plants would again be in operation manufacturing explosives and munitions in a new defence program.

#### PROSECUTIONS

There were 85 violations of the Explosives Act and Regulations in which proceedings were entered and of these, 77 convictions were secured and fines imposed. The offences are grouped as follows:

- Improper storage.
- Failure to keep proper records of sales.
- Illegal transportation.
- Selling explosives without a licence.
- Smoking in prohibited areas.
- Breaking down explosives.
- Trespassing.

From 1944 to the end of 1946, when Defence of Canada Regulations were still in force, 32 persons were charged under P.C. 2903, 4th July 1940, with failure to obtain an Explosives Purchase Permit. Over 300 persons were charged under P.C. 3561, 30th April, 1942, for smoking or possessing matches in explosives factories and fines up to \$100 and jail sentences of

3 months were imposed. Many charges involving explosives were laid under the Criminal Code of Canada, Provincial Mines Acts and city by-laws for offences such as theft, careless use, etc. Some offenders were sentenced to long prison terms.

Two toy pistol cap factory operators were prosecuted, convicted and fined for illegal manufacture of toy caps.

### SAFETY PAMPHLETS

Since accidents to children formed almost one third of the total, and were primarily attributable to the finding of carelessly stored explosives, efforts are being made through the schools by lectures, films and posters to teach children to recognize explosives, particularly detonators and blasting caps, and warn them of the danger of playing with them. A pamphlet was distributed in two provinces through the agency of the Farmers' Institute, warning farmers of the dangers of hiding detonators in barns and sheds. Careless storage of surplus explosives by road workers is also a common cause of accidents, and accordingly, a warning poster and circular letter were sent out, bringing many requests for additional copies of the poster from provincial government departments and other large users.

### BLASTERS' PERMITS

Reference might be made here to action taken by some provinces in the interest of safer use of explosives. The use of explosives does not come under the jurisdiction of the Explosives Act but the Division has co-operated with the provinces in this matter. Quebec was the first to require "powder men" engaged in blasting operations (apart from those in mines and quarries) to have a blaster's permit. The Quebec Department of Labour accepts applications for such permits from approved men, when the application is accompanied by a satisfactory sworn statement of experience. No examination, oral or written, is required. The Workmen's Compensation Board of Alberta also issues a blaster's permit and similar action has been taken by The Workmen's Compensation Board of British Columbia. The latter, however requires all workmen who use explosives and come within its jurisdiction, to pass an oral and written examination before a blaster's permit is granted. This action of the provinces restricting shot-firing to competent men cannot but have a salutary effect on safety standards and the prevention of accidents. Industries using explosives will profit, for "powder men" with certified credentials will prove more reliable, less wasteful of explosives and less likely to have accidents, thus minimizing the loss of time and dislocation of work schedules which invariably follow.

### EXPLOSIVES TESTING LABORATORY

During the war and the years following, in addition to routine examination and testing, chemists of the Explosives Division carried on much research on the properties of military and commercial explosives for various government departments and committees and for the explosives industry generally. The Royal Canadian Mounted Police, Department of National Defence, Post Office Department, National Research Council, Board of Transport Commissioners and other government agencies submitted

samples for examination and problems for investigation on matters pertaining to explosives. Members of the chemical staff devoted time to conferences and committees in Canada and the United States and delivered lectures on explosives at Police colleges and other gatherings.

An active part has also been taken in the Advisory Conference on Ammonium Nitrate Fertilizer convened by National Research Council and comprised of representatives of ammonium nitrate manufacturers, transport and harbour authorities and other interested agencies. The practical object of this investigation was to provide data, formerly lacking, on the basis of which appropriate specifications and regulations could be framed to ensure safety in packing, handling, storage and transportation. Laboratory tests and field trials, on the nature and explosive properties of ammonium nitrate fertilizer, were conducted by the chemical staff of the Division for the information of the Advisory Conference. The results of these studies are compiled in three interim reports issued by the National Research Council. Early studies appear to indicate that only extremely large masses of ammonium nitrate can provide sufficient self-confinement to assure propagation by detonation. Later studies show that the gaseous products of decomposition, and pressure, are important factors in detonation. The need of free ventilation and the use of containers incapable of maintaining more than a few atmospheres of pressure are, consequently, considered essential requirements for safe stowage, packing and transportation of ammonium nitrate fertilizer.

## AUTHORIZATION OF EXPLOSIVES

Before explosives may be manufactured in or imported into Canada they must be authorized in accordance with the procedure outlined in Explosives Regulations, Part II, The Explosives Act 1946. A list of authorized explosives is given in Appendix F. From 1944-1951 inclusive, 60 samples of high explosives were submitted for examination, 54 being authorized and 6 rejected. Five hundred and ninety one samples of fireworks, including Chinese firecrackers, toy pistol caps, signal flares and fuses were tested, 471 of which were authorized and 120 rejected.

## EXPLOSIVES

### *Stolen*

One hundred and thirty three thefts of explosives from magazines and unlicensed premises were reported during the eight year period. Some 7,080 pounds of blasting explosives, 37,042 detonators, 1,815 feet of fuse and 31,720 rounds of ammunition were stolen, some of which was recovered by the police. Several unsuccessful breaks-in were reported.

The interest manifested by many magazine operators in protecting magazines against unauthorized entry was most commendable. Many made locks of original designs which successfully withstood attempts at unauthorized entry.

### *Found*

One hundred and thirty-one different lots of explosives were reported found, made up of large quantities of commercial explosives abandoned by contractors or mining companies, small quantities of nitroglycerine,

hidden by safebreakers and military stores discarded on practice ranges. Explosives found included 33,543 pounds of blasting explosives, 159,500 detonators and 8,007 feet of fuse.

### *Destroyed*

Large quantities of explosives were destroyed during the eight years, including deteriorated material condemned in magazines totalling 53,909 pounds of blasting explosives, 39,603 detonators and 1,000 feet of fuse. Of explosives found or abandoned, some 320,159 pounds of blasting explosives, 249,069 detonators, 13,958 feet of fuse, and over 30,000 pounds of unauthorized fireworks were destroyed. One million rounds of unserviceable S.A.A. were also destroyed. Over 200,000 pounds of magnesium powder, 60,000 tubes of anti-gas ointment and several cases of pyrotechnic stores were disposed of for War Assets Corporation. In most of these destructions, the work was carried out under the supervision of an officer of the Division.

An unusual happening occurred during the period under review. Part of a shipment of sodium nitrate, which was later found to have a high sodium nitrite content, was used in the manufacture of explosives containing gelatinized nitroglycerine. Reports were received that certain explosives were exuding nitroglycerine. The sodium nitrate referred to had been used in their manufacture and it was found that, in hot weather in the presence of ammonium nitrate, sodium nitrite could cause the separation of the nitroglycerine from the gelatinizing agent. The manufacturer, at great expense, took back where possible the unused explosives but where the explosives had been shipped to inaccessible areas from which they could not conveniently be returned, a team was sent to destroy them.

## COMMERCIAL EXPLOSIVES FACTORIES

The explosives industry, once regarded as one of the most dangerous, has become one of the less hazardous. The change may be attributed to the acceptance of discipline and the contributions of employees to high standards of safety. In the years 1948 to 1951, inclusive, no fatality or injury involving high explosives occurred in manufacture. This was achieved notwithstanding that record production was attained in each of these years.

Conditions in factories manufacturing detonators, primers, etc. differ somewhat from those found in high explosives factories. In the former, despite every precaution, flashes and minor explosions can scarcely be avoided in some operations because of the sensitive nature of the explosive compounds handled. Fortunately, the quantities involved are generally relatively small and adequate measures can be taken in the way of barricades, screens, remote control operations and like safeguards to protect personnel and equipment and to localize the effect of explosions when they do occur.

The work done by safety committees in explosives factories continues to prove of invaluable aid to safety and at the same time to the administration of the Explosives Act. Careful consideration by plant safety committees to suggestions for eliminating real or possible hazards helps to secure safe working conditions and the maintenance of high standards. Management-sponsored competitions and educational posters also play important parts

in preventing accidents and those factories that insist on good house-keeping are undoubtedly safer places in which to work and at the same time more efficient in operation.

Fatal accidents involving explosives can be related to production since the Explosives Act came into force. For the 10 years 1919 to 1929, the average number of deaths per million pounds of explosives produced was 1.25, for the years 1929 to 1939 0.95, and for 1939 to 1948 0.35. If fatal accidents in manufacture only are considered, the picture is even brighter.

The production of blasting explosives in 1919, the first year recorded under the Explosives Act, amounted to 21,215,000 pounds and from then until 1930 there was a steady annual increase. Thereafter production suffered a drop which was not completely overtaken until 1941 when a new peak of 84,633,000 pounds was reached. This was followed by a gradual decline during the war, but a new record was reached in 1949 with the production of 85,196,000 pounds. In each subsequent year, production has continued to increase until a new peak of 107,339,000 pounds was attained in 1951.

In 1947, four new toy pistol cap factories came into production, and a former factory was re-opened. The public demand for this type of firework continues to be maintained.

#### *Accidents in Manufacture*

Any accidental explosion coming within the jurisdiction of the Explosives Act, whether or not accompanied by injury, must be reported immediately to the chief inspector of explosives and may be investigated by an officer of the Division. The principal object of the inquiry is to ascertain, if possible, the cause of the explosion and to recommend measures to avert recurrence. In factories manufacturing detonators, primers and small arms ammunition, minor flashes and explosions occur almost daily. Reports of these are submitted monthly but, for explosions not of the general run, notice must be given immediately.

#### **1944**

Two accidents occurred during the year in commercial explosives plants which resulted in material damage but no loss of life. On the 15th of March, at Beloeil Works, Canadian Industries Limited, the corning mill in the black powder plant was completely destroyed by an explosion, the cause of which could not be determined. Failure of some moving part or change in shaft alignment due to frost were considered possibilities.

On December 9th, also in the black powder plant, Beloeil Works, fire broke out in the electric starter house from which sparks, blown by the wind, communicated fire to the wheel mill and set off a 600-pound charge of black powder. The cause of the fire was attributed to overheated resistors in the starter house. The following changes in design of the new electric starter house were recommended:—

- (1) Electrical switches should be mounted on metal frames instead of wood.
- (2) A clear space of at least 3 feet should be left in front of electric switches and starters.

- (3) Open type resistors should be mounted on metal framework away from combustible material, and should be protected by heavy wire screen.

Minor flashes were reported in detonator and small arms plants as follows:—

Detonators.....	22
Primers.....	52
Small Arms Ammunition.....	11
Railway Fusees.....	2

## 1945

In the early morning of February 23rd, at Beloeil Works, Canadian Industries Limited, a fire was discovered in the dynamite box packing house. A steam pipe in contact with wax impregnated asbestos insulation was thought to have started the fire. Fortunately, the fire did not reach explosives stored overnight in the building before they were removed, at some risk. The damage amounted to about \$700. Changes were made in the steam pipe lay-out and overnight storage of explosives in this building was forbidden.

On August 14, (V-J Day), at Depot Harbour, Ontario, fire completely destroyed a large wooden storage shed which at the time was being used to store cordite. Over 3,000,000 pounds of cordite burned. There were no casualties. The fire was started by wind-carried burning embers from a grain elevator, in which fire had broken out, 800 feet across a bay from the storage shed. The fire spread rapidly and the guards, after attempting to bring it under control, were forced to withdraw. Because of the large quantity of cordite involved—the largest fire of this kind ever to occur in Canada—it is of more than passing interest to note that no violent explosion or any action comparable to detonation occurred, yet the entire quantity of cordite burned in about ten minutes. Fire spread to a nearby shed which was destroyed along with a large quantity of wool stored in it, but major damage otherwise was confined to the sheds and dock. The manufacture of cordite had ceased in Canada at this time but it was recommended that, in selecting sites for cordite storage depots, outside hazards should receive careful attention.

A serious accident occurred on August 29th, at Brainerd Works, Canadian Industries Limited when a gelatine cartridge house blew up, killing three men. The explosion took place during "clean-up" after cartridge operations had been completed. Two machine operators who were in the building and a trucker who was outside lost their lives. Approximately 300 pounds of gelatin was involved. No definite cause of the accident could be discovered but from a study of the evidence the following were considered possibilities:—

1. Some inadvertent but undetermined act of one of the operators.
2. Flaws in the "worm" in the cartridge machine, which permitted the accumulation of nitroglycerine in small pockets in the metal.
3. Fouling of the revolving worm by the wooden paddle used in clean-up operations.

Several changes were made following the accident:

1. The practice of plating the "worm", a solid brass casting, with chromium was discontinued since plating covered up defects, the hazards of which were not always appreciated by the maker.
2. Powder buggies were redesigned to eliminate upsetting.
3. Blades on the worm shaft were removed so that the wooden shovel, used to feed the machine, could not be caught between the revolving blades and the hopper.

Two other accidents in commercial explosives plants occurred which resulted in material damage but no injury to personnel. The glaze mill in the black powder plant, Beloeil Works was struck by lightning shortly after midnight on April 17th and 6,000 pounds of powder exploded. The building was completely destroyed. The operators, in accordance with regulations and safety instructions, shut off the power on the approach of the storm and retired to a safe distance. Major damage was confined to the glaze mill.

On December 31st, an explosion occurred in a small magazine containing about 100 pounds of laboratory samples. The magazine was totally destroyed. There was no positive evidence to indicate the cause of the accident but overheating of the magazine by a defective steam line was considered to be the most likely cause. It was recommended that:—

- (1) Magazines of this kind be inspected more frequently.
- (2) Any unusual conditions of temperature be immediately reported.
- (3) Even small samples of lead azide, fulminate of mercury etc., be kept separate from other explosives.

Minor flashes and explosions were reported from detonator and small arms plants as follows:

Detonators.....	4
Primers.....	66
Small Arms Ammunition.....	12
Railway Fusees.....	1

## 1946

On January 15th, an accident occurred at Brownsburg Works, Canadian Industries Limited when approximately 3 pounds of primer composition exploded during mixing operations. Damage to building and equipment was estimated at \$3,000. The evidence indicated that the operation was being conducted in a normal manner. Static discharge was therefore considered to be the most probable cause and changes were recommended in the design of the building and equipment to give better control of humidity and ensure complete grounding.

A fire, which occurred on April 4th, in a Hall cartridging machine house, Beloeil Works, Canadian Industries Limited, completely destroyed the building and equipment, with a loss estimated at \$30,000. No one was injured. Although a large quantity of explosives burned, there was no explosion. The fire was first observed by the Hall machine operator, at one end of the feed hopper, from where it spread rapidly, leaving barely

time for operators to get out of the building. Accidental introduction of foreign material into the feed hopper, resulting in friction, appeared to be the most likely cause.

A serious accident took place at James Island Works, Canadian Industries Limited, on September 26th, when a gelatin cartridging house blew up, killing three men and causing injuries to two. Careful investigation of the circumstances attending the accident failed to determine the cause, but probable causes were:

- (1) Impact—the result of dropping a box of powder.
- (2) Foreign material in the gelatin.
- (3) A wooden spade becoming caught in the cartridging machine hopper.
- (4) Imperfections in the worm concealed by chromium plating.

Recommendations made included:

- (1) Removal of blades over the worm.
- (2) More careful screening of ingredients.
- (3) A closer check on mixing procedure when “rework” powder is incorporated.
- (4) Use of unplated worms.

Minor flashes and explosions were reported and in some instances operators suffered slight injuries. Where the cause was determined, corrective measures were taken. The numbers of these occurrences were as follows:

Detonators.....	4
Primers.....	74
Small Arms Ammunition.....	269
Railway Fuses and Track Signals.....	6

## 1947

During the year there were two fatal accidents involving explosives, both of which occurred in the manufacture of fireworks. On May 13th, a two-year-old child was fatally burned in a flash fire in the basement of a house in Toronto where toy caps were being manufactured illegally. A thorough investigation was made by deputy inspectors of explosives of the Royal Canadian Mounted Police but as prosecution proceedings were taken by the Ontario Provincial Government under the Ontario Factories Act, no action was entered under the Explosives Act.

The wife of the proprietor of a small licensed fireworks factory was fatally burned in an explosion on July 30th. She was filling “Aerial Star Bombs” on a bench in the open when a sudden flash occurred, probably caused by friction from the use of unauthorized tools. It was recommended that:

- (1) The quantity of explosives in the filling operation be kept to the very minimum.
- (2) Containers be kept covered.
- (3) No iron or steel parts be permitted in the equipment.
- (4) A suitable covering of masonite or linoleum for the work bench be provided.

Flashes and minor explosions, some of which resulted in slight injuries to personnel, were reported by explosives factories as under:

Detonators.....	2
Primers.....	85
Small Arms Ammunition.....	1,197
Railway Fusees and Signals.....	4

### 1948

One major accident occurred in the manufacture of fireworks, when the proprietor of a toy cap factory was killed by an explosion of sheets of caps. The man was alone in the factory at the time. An investigation was carried out by an officer of the Division and evidence indicated that the unauthorized and dangerous practice of pressing dry sheets of caps was being performed, concerning which the proprietor had previously been warned.

A flash of rim fire priming powder in the primer department of the Brownsburg Works, Canadian Industries Limited, resulted in injuries to the operator. Re-wet priming powder was being moved with a spatula preparatory to rubbing it into the charging plate. A flash occurred which was thought to be due to dry powder on the bottom of the spatula. More frequent checking of equipment was instituted.

An explosion of an experimental batch of "matchhead" composition took place in the development department of Brownsburg Works. The mixture was being put through a sieve, using a 1-inch paint brush. The chemist in charge of the work received minor injuries to his hands and face. Static electricity was believed to have caused the explosion and means for correcting this were devised.

The following minor accidents occurred in explosives factories, in some instances with slight injuries to operators:

Detonators.....	1
Primers.....	140
Small Arms Ammunition.....	934

### 1949

No accident involving explosives, took place in any of the factories making blasting explosives.

Two flash fires occurred at the T. W. Hand Fireworks Limited, Cooksville, Ontario in which two persons were injured. On February 11th, an employee entered the laboratory, carrying "Green Stars" in an open box. A spark from a burning star, which was being tested in a fume cabinet, ignited the stars in the box and the employee was burned about the face.

On June 27, a woman employee suffered burns. She had been filling "Yellow Lances" and it is thought she used a brass ram to force the composition through the filling funnel.

An explosion occurred in centre-fire primer charging operations, Brownsburg Works, Canadian Industries Limited. The charge had been found to be underweight and to correct this, extra strokes were given.

Damage to equipment and building was fairly extensive but the operator suffered minor bruises only.

While dumping scrap powder at the burning ground of the Brownsburg Works, the powder flashed and the operator suffered slight burns to his left arm. About 15 pounds of powder was involved. The specified procedure was being followed, but unusually hot weather was thought to be a contributing factor.

During the dismantling of a rim fire priming machine at Brownsburg Works, a flash occurred resulting in injury to the operator's right index finger. Set screws on the machines will be sealed with wax to keep out powder.

Minor incidents are listed as follows:

Detonators.....	7
Primers.....	117
Small Arms Ammunition.....	649
Railway Fusees.....	4

### 1950

An explosion occurred at the T. W. Hand Fireworks Limited, Cooksville, Ont., on August 4th. Four employees were injured, two seriously. Friction, the result of careless handling of uncut sheets of caps, was believed to have caused the explosion.

A flash fire occurred at the same factory on September 13th, and one employee received burns and eye injuries. The injured man, passing through the cap room, stopped to examine the stamper. It is thought the metal zipper of his jacket came in contact with dry cap composition which had not been completely removed when the stamper was cleaned.

At Valcartier Works, Canadian Arsenals Limited an operator was severely burned and later died; he was removing an explosive mixture from a drum when the material ignited.

Minor flashes and explosions occurred in the following manufacturing operations:—

Detonators.....	1
Primers.....	108
Small Arms Ammunition.....	1,007
Railway Fusees.....	2

### 1951

A serious accident occurred at the shell filling plant of Canadian Arsenals Limited, on February 7th, when five employees were killed. A shell filling was being probed for cavitation when it exploded. A board of inquiry under the chairmanship of the chief inspector of explosives, conducted an investigation and submitted a report. Recommendations made have since been fully implemented.

On the 27th August, at Brownsburg Works, Canadian Industries Limited, an explosion—unique in many years of operation—occurred in

the dumping and sieving of blasting caps which follow filling and pressing. Approximately 2,500 No. 6 blasting caps were involved in the explosion. One operator received a slight burn on the left arm, and equipment was badly damaged. The substantial nature of the containing walls of the building and its well planned protective design prevented serious injury to personnel or major damage to adjacent buildings.

Cause of the accident was believed to be faulty operation of a sawdust "dispenser". It was found that sawdust could form a bridge in the hopper, stopping or slowing up the discharge of the sawdust which served as a cushion for the detonators as well as a cleaning agent. To correct this fault a stirring device has been installed inside the hopper which should prevent bridging.

Two explosions at the Brownsburg Works, Canadian Industries Limited, each involving 200 No. 6 blasting caps, occurred during the second charge pressing. Equipment was damaged considerably in each case, and one operator received minor injuries. Excessive friction between the pressing punch and cap wall was thought to be the cause and the plate has been redesigned to eliminate this possibility.

While timing short period delay detonators a technician suffered lacerations and puncture wounds when one exploded in his left hand. Apparently he had inadvertently connected the leads to a source of electric current.

An explosion occurred in the primer department, Brownsburg Works, on September 10th, when 20 ounces of primer composition ignited. The operator suffered a broken wrist. It was thought that dry particles ignited under friction.

Minor flashes and explosions occurred as follows:

Detonators.....	20
Primers.....	97
Small Arms Ammunition.....	1,005
Railway Fusees.....	10

#### *Accidents in Use*

Despite a steady rise in the production and use of commercial explosives, the number of accidents has not shown a corresponding increase. During the past eight years the peak in accidents was reached in 1948 when 36 persons were killed and 166 injured; these are equivalent to 0.46 deaths and 2.1 injuries per million pounds of blasting explosives manufactured and used. Since 1948 accidents have decreased while production has risen sharply. In 1951 deaths were 0.24 and injuries 1.1 per million pounds of explosives produced.

Appendix "D" Part I shows the various accidents grouped under their probable causes. Part II gives a brief description of typical examples of accidents, the results of playing with detonators and other explosives. Part III is a graph showing the relation between production and accidents.

Accidents arising from the use of blasting explosives accounted for more than 50% of the total reported. The commonest causes in order

were:—(1) returning too soon, (2) failure to get away from the shot hole, (3) projected debris, and (4) not taking sufficient cover. While it is true that some accidents are the results of unavoidable or unforeseeable circumstances many are due to carelessness and failure to appreciate the risks.

The Department of Mines in each province has drawn up regulations, under its Mines Act, requiring observance of recognized good practice in the use of explosives in the mining industries. Outside of mines and quarries three provinces, Alberta, British Columbia and Quebec require a blaster's permit without which a man cannot obtain employment as a shot firer. The Explosives Division has issued pamphlets and posters to assist the casual user of explosives, elsewhere than in mines and quarries.

### MILITARY EXPLOSIVES FACTORIES

Some reference to the work of the Division in connection with military explosives factories during the years 1940 to 1945 may be of interest. All military explosives factories were licensed under the Explosives Act and were subject to regulations made thereunder. Regular factory inspections and enquiries into the circumstances attending accidents were carried out by inspectors of the Division. The inspection of war factories occupied the full time of one inspector and much of the time of others.

Twenty explosives factories were built during the war. To meet the constantly changing requirements of the armed forces many modifications of these plants were made in the course of their operation. The task of striking a balance between safety and urgent production demands was not always easy. Happily, decisions of this kind were made less difficult by the co-operative attitude of management in recognizing that safety was not incompatible with efficiency of operation.

The full story of Canada's production of military explosives cannot be dealt with in this report. Production of a wide variety of munitions of war, most of them not previously made in Canada, demonstrated the capacity and adaptability of the Canadian explosives industry. Previous to World War II only one manufacturer had the facilities for, and produced high explosives. The experienced personnel of this company had therefore thrust upon them much of the task of manning, training new help and operating many of the new explosives plants which were built. The knowledge possessed by this relatively small group of men—although greatly attenuated in the vast expansion which took place—constituted the vital framework about which much of Canada's war effort in the field of explosives was built. Important also were the efforts of several manufacturers who had had no previous experience in the manufacture of explosives, some of whom established remarkable production and freedom-from-accident records. Owing to the large body of inexperienced help, the task of teaching safety was a formidable one, but eagerness to learn offset, to a greater degree than was thought possible, the risks entailed in a hazardous and rapidly expanding industry.

No estimate of the production of military explosives during the war can be given but the following figures published by Canadian Industries Limited for a group of ten explosives plants, indicate its magnitude.

T.N.T.....	137,000 tons
Cordite.....	117,000 tons
Smokeless Powder.....	67,000 tons
Miscellaneous Explosives.....	14,000 tons
Rifle and Machine Gun Ammunition.....	2,710,000,000 rounds

In addition, millions of primers and detonators were produced, 139,000,000 units consisting of shells, bombs, depth charges, cartridges, torpedo war heads, land mines, rockets, etc., were filled with explosives and 41,000,000 shell fuzes assembled.

These figures do not include much of the output of the largest shell-filling plant which, in addition to shells of many calibres, turned out immense quantities of hand grenades, detonators, smoke shells, etc. Nor do they include the output of factories manufacturing fuzes, R.D.X., picrite and a variety of military pyrotechnics.

#### *Accidents in Manufacture*

In Appendix E is given a summary of accidents which occurred in factories manufacturing military explosives and munitions in the years 1940 to 1945. The accident record of the factories making these explosives during the war compares favourably with those of other industries thought to be much less hazardous. Some factories despite the ever present risks, recorded no fatalities. Considering the speed of production and the large body of inexperienced employees, such a record is highly creditable.

In the 6 years during which military explosives plants operated forty-three people lost their lives and three hundred and twenty sustained injuries. The filling of military detonators, performed largely by women, was responsible for most injuries. The one hundred and twenty nine injuries suffered were chiefly to fingers and hands. The two accidents resulting in the greatest number of fatalities did not occur in high explosives factories but in the manufacture of cordite and smoke composition. Both accidents were primarily fires with only slight explosive effects.

Many safety devices, some simple and others of much ingenuity, were developed during the war to reduce manufacturing hazards. Some improvements were made in the method of filling military detonators but it was not until a few years ago that serious thought was given to a mechanical method to replace hand filling. Canadian Arsenal Limited has designed, built and now operates a detonator-filling machine of great promise. This machine eliminates the handling of military detonators in filling operations and thus removes the danger of hand and finger injuries.

### IMPORTS

Authorized explosives may be imported into Canada by permit issued by the Minister, chief of which are nitrocotton for use in the manufacture of paints and lacquers, propellant powders used in the manufacture of ammunition, explosives used in seismograph exploration for oil and

fireworks. Imports of Chinese firecrackers which ceased during the war were resumed in 1946, principally through the Port of Vancouver. The quantities of explosives, arranged according to the classes and divisions, imported under permits during 1944-1951 are shown in Appendix C. During the eight years 3,810 ordinary import permits and 163 special permits were issued.

### NEW EXPLOSIVES

In 1948 an improved type of delay action detonator was made and marketed in Canada; its development marked, perhaps, the most important advance in this field in many years. The new detonator has proved of great value, especially in quarry operations as it greatly reduces earth vibrations, improves breakage and increases the quantity of rock moved. The burning rate of the timing device is the essential element on which the improvement depends. Formerly the burning time of delay elements was rated in seconds; the new elements function in milliseconds.

Detonating fuse, "Primacord", formerly imported, was manufactured in Canada for the first time in 1947. Another new product, "Igniter Cord", developed by the same manufacturer is also made in Canada and has special application in multiple shot-firing with safety fuse.

### NEW HIGH EXPLOSIVES FACTORY

The growing demand for explosives in the western provinces resulted in the construction of a new explosives factory near Calgary, Alta., begun in 1950. Much thought and planning has gone into the design of this plant and its operation will be of special interest because of its many new features and labour-saving equipment. Nitroglycerine will be manufactured by the "Biazzi Process", the invention of a Swiss engineer and not heretofore used in Canada. This process has been in use in Europe for some years and has an excellent accident-free record. Its chief advantage from a safety point of view, lies in the small quantity of nitroglycerine, in the unstable state, in the nitrator. It has, in addition, many safety devices which control and regulate nitration and purification and thereby reduce the risks of explosion.

Many of the process operations in the new factory will be mechanized and manual labour will be reduced to a minimum. Labour saving installations will include mechanical discharge of the mixing machines, "direct casing" in cartridging houses and transfer of explosives by roller conveyer from the cartridging houses to the packing house. Many minor innovations have been made and the factory will be as safe and efficient as planning can make it. Mechanization reduces manual labour and fatigue but places added responsibility on supervisors and maintenance men to ensure, at all times, the mechanical soundness of the equipment. The Calgary plant is expected to go into production in 1952 and its operation and progress will be followed with great interest.

## APPENDIX A

## FACTORIES LICENSED TO MANUFACTURE EXPLOSIVES 1944-1951

Owner	Location of factory	General nature of product	Remarks
Canadian Industries Ltd. ....	Beloeil, Que.....	Blasting explosives, black powders, propellants.	
Canadian Industries Ltd. ....	James Island, B.C...	Blasting explosives.	
Canadian Industries Ltd. ....	Nobel, Ont.....	Blasting explosives.	
Canadian Industries Ltd. ....	Brainerd, Man.....	Blasting explosives.	
Canadian Industries Ltd. ....	Brownsburg, Que...	Ammunition, detonators, fusees, etc.	
Canadian Safety Fuse Co...	Brownsburg, Que....	Safety Fuse, detonating fuse. Fuse lighters.	
Canadian Arsenals Ltd. ....	Beloeil, Que. ....	Time Ring Fuse Powder.	
Canadian Arsenals Ltd. ....	St. Paul l'Ermite, Que.	Filling military shells, fuses, etc.	
Canadian Arsenals Ltd. ....	Valcartier, Que....	Filling military small arms ammunition.	
Canadian Arsenals Ltd. ....	Valleyfield, Que....	Military explosives, propellants.....	Operated by Defence Industries (1951) Ltd. 1951.
North American Cyanamid Ltd.	Niagara Falls, Ont..	Nitroguanidine.....	Re-opened 1951.
T. W. Hand Fireworks Co....	Cooksville, Ont....	Fireworks and military pyrotechnics.	
Macdonald Metals & Plastics..	Waterloo, Que.....	Toy pistol caps. ....	Re-opened 1947.
Montreal Fireworks Co.....	Ville St. Pierre, Que.	Display fireworks.	
Superior Toy Co.....	Waubashene, Ont..	Toy pistol caps. ....	Licensed 1947-1951.
W. F. Bishop & Son.....	Unionville, Ont....	Fireworks. ....	Licensed 1949-1951.
Joseph J. Godin (Interstate Fireworks)	Newmarket, Ont...	Fireworks. ....	Licensed 1950-1951 Storage only.
Atta Toy & Novelties Co. Ltd.	Scarboro, Ont.....	Toy pistol caps. ....	Licensed 1947 only.
Last Minute Mfg. Co. Ltd.....	Thorold, Ont.....	Toy pistol caps. ....	Licensed 1947-1948 only.

# APPENDIX B Production of Explosives in Canadian Factories 1944-1951

Year	Class 1		Class 2		Class 3		Class 6 * Ammunition					Class 7
	Gunpowder	Nitrate Mixtures	Nitro Compounds		Div. 1	Div. 2	Safety Cartridges	Safety Fuse and Primacord	Railway Track Signals	Percussion Caps	Detonators and Electric Detonators	Fireworks † (Approximate Value)
			lb.	lb.								
1944	lb. 64,000	lb. 401,000	53,581,000	lb. .....			rounds 246,312,000	output of one factory	output of one factory	output of one factory	output of one factory	\$ 253,155
1945	1,007,000	977,000	51,182,000	2,752,000			215,604,000	"	"	"	"	262,498
1946	84,000	904,000	57,348,000	.....			267,343,000	"	"	"	"	524,106
1947	75,000	1,101,000	67,715,000	1,000			323,470,000	"	"	"	"	702,075
1948	.....	834,000	77,296,000	.....			357,308,000	"	"	"	"	738,783
1949	.....	665,000	83,931,000	600,000			330,640,000	"	"	"	"	679,996
1950	.....	573,000	90,478,000	2,439,000			185,440,000	"	"	"	"	718,351
1951	.....	671,000	103,863,000	14,852,000			267,840,000	"	"	"	"	973,491

\* Exclusive of artillery ammunition and small arms ammunition made in Government factories.

† Commercial and display fireworks, fuse lighters, toy caps and fuses.

# APPENDIX C Explosives Imported into Canada

Class	Division	Description	Quantity							
			1944	1945	1946	1947	1948	1949	1950	1951
I		Gunpowder.....	67,709 lb.	2,480 lb.	.....	7,103 lb.	10,368 lb.	.....	90,412 lb.	33,917 lb.
II		Nitrate Mixtures.....	.....	7,513 lb.	4,461 lb.	.....	.....	19,723 lb.	112,946 lb.	160,323 lb.
III	1	Mixtures containing liquid nitro-compound.....	2,012,178 lb.	2,944 lb.	6,341 lb.	2,507 lb.	3,309 lb.	80,850 lb.	358,592 lb.	107,030 lb.
	2	Nitro-Compounds:—	5,927,760 lb.	262,813 lb.	215,087 lb.	438,770 lb.	283,880 lb.	301,164 lb.	212,625 lb.	48,161 lb.
		(a) Propellants.....	61,000 lb.	25,000 lb.	8,625 lb.	14,025 lb.	39,400 lb.	38,682 lb.	59,239 lb.	431,430 lb.
		(b) For use in explosives factories.....	8,305,553 lb.	3,458,589 lb.	2,517,194 lb.	2,411,363 lb.	2,849,908 lb.	2,544,717 lb.	4,936,386 lb.	3,597,364 lb.
		(c) For other manufacturing purposes.....	63,731 lb.	57,699 lb.	150 lb.	100 lb.	.....	45 lb.	285 lb.	200 lb.
V		Fulminates.....	.....	.....	.....	.....	.....	.....	.....	.....
VI	1	Primers.....	1,858	15,100	2,000	34,000	1,000	106,750	38,421	742,000 only
	3	Detonators.....	386,100	62,612	49,020	107,028	575,135	20,875	50,400	42,900 only
	1	Safety fuse.....	183,350 ft.	285,000 ft.	20,000 ft.	100 ft.	121,000 ft.	6,600 ft.	9,550 ft.	12,000 ft.
	2	Miners' squibs.....	270 lb.	.....	.....	345 lb.	.....	.....	.....	30,000 only
	2	Detonating fuse.....	1,825,600 ft.	1,664,000 ft.	1,593,100 ft.	2,276,500 ft.	7,980 ft.	10,500 ft.	5,174 ft.	19,000 ft.
VII	2	Manufactured fireworks.....	9,070 lb.	2,014 lb.	50,181 lb.	73,113 lb.	676,703 lb.	1,137,044 lb.	377,740 lb.	364,680 lb.
		Miscellaneous.....	.....	.....	.....	.....	43 lb.	115 lb.	278 lb.	50 lb.

## APPENDIX D

## PART I

## Accidents from Explosives

1944-1951

Year	Use			Manufacture			Keeping and Conveyance			Playing with detonators			Playing with other explosives			Miscellaneous			Total		
	Acci- dent	Killed	Injured	Acci- dent	Killed	Injured	Acci- dent	Killed	Injured	Acci- dent	Killed	Injured	Acci- dent	Killed	Injured	Acci- dent	Killed	Injured	Acci- dent	Killed	Injured
1944	64	8	72	2	0	0	.....	.....	.....	14	1	16	28	6	35	1	.....	1	109	15	124
1945	61	9	61	2	3	1	.....	.....	.....	13	2	18	35	8	44	8	.....	16	119	22	140
1946	87	19	78	3	3	0	.....	.....	.....	10	.....	10	27	.....	36	13	5	14	140	27	138
1947	95	28	105	14	2	7	.....	1	.....	14	.....	19	17	1	22	4	.....	4	147	32	157
1948	107	28	108	17	1	6	.....	1	.....	14	.....	19	20	4	27	4	2	6	165	36	166
1949	94	22	90	14	0	7	.....	.....	.....	13	3	19	17	.....	21	2	.....	3	141	25	158
1950	73	10	78	17	0	5	.....	1	.....	11	.....	13	12	1	19	3	1	4	120	13	123
1951	68	18	81	8	0	10	.....	.....	.....	12	1	15	13	3	18	3	6	3	104	28	127

## APPENDIX D

## PART II

Typical Examples from the Files of the Explosives Division, 1944 to 1951.

## PLAYING WITH DETONATORS

7 persons were killed and 129 injured.

Cause of Accident	Killed	Injured
Boy, age 13, found a detonator in an old granary, carried it in his pocket for several days, and then placed a lighted match in the open end, causing an explosion. He lost the thumb and first two fingers of his left hand and received lacerations to his face. ....		1
Boy, age 9, found a box of detonators hidden beside a fence post on his father's farm, applied a lighted match to a detonator and lost part of his thumb and three fingers, in the ensuing explosion. ....		1
School children found some electric detonators in an old building belonging to a highway department, took them to school, and built a fire into which they threw the detonators. A young boy standing nearby received injuries to his face. ....		1
Boy, age 13, found some detonators in the eaves of a barn and tried to remove the composition from a detonator with a darning needle. It exploded, causing injuries to his thumb and two fingers. ....		1
Girl, age 12, while visiting her grandfather's farm, found a detonator and held a lighted match to it. In the resulting explosion she lost her thumb, the tips of several fingers and received injuries to her left eye. ....		1
Boy, age 14, with two companions, found several detonators and fuse in a greenhouse near his home. The boys attached short pieces of fuse to the detonators, then lit the fuse and tossed the detonators in the air. One boy held one too long, he lost a thumb and received injuries to several fingers. ....		1
Boy, age 8, found a box of detonators in a house that was being dismantled. He placed a match in one detonator and hit it with a stone held in his hand. The resulting explosion blew off the thumb and two fingers of his left hand. ....		1
Boy, age 7, found a number of detonators in an old shed; while he was playing with them, one exploded, causing the loss of his left eye. ....		1
A miner left two tins of blasting caps in a cabin. A 14 year old boy found the caps and struck one with a stone, causing it to explode. He lost the thumb and two fingers of his left hand and received burns to his face. ....		1
Boy, age 9, found some detonators on the shelf of an old shack formerly used by a construction company. He put them in his pocket and, while playing in his yard, lost them. Later, he gathered some chips in the yard to start a fire in the stove and as he leaned over the stove to blow the flames, an explosion occurred. He received fatal injuries and his young brother lost an eye. ....	1	1
Boy, age 9, found a box of detonators in a building under construction and distributed them to his school chums. One boy was using the detonator as a "whistle", when it exploded blowing two fingers and part of a third off his right hand and causing injuries to his face and right eye. ....		1
Boys, age 12 and 6, found a box containing 6 detonators. The older boy put one on the kitchen stove and it exploded, setting off another the younger boy had in his hand. One boy lost an eye and the other, two fingers. ....		2
Girl, age 16, found some detonators in an ice house. She took them to school, and while picking one with a bobby pin it exploded. She lost an eye, parts of two fingers of one hand and one finger of the other. In addition, her face and chest were pitted with small pieces of metal. ....		1
Boy, age 17, and some companions broke into a magazine and stole a box of detonators and some fuse. He placed the box inside his belt and, while lighting the fuse, set off the entire box. He died from injuries. ....	1	
Three teen-age boys, working in a lumber camp, obtained some detonators and fuse. They were amusing themselves by inserting short pieces of fuse in the detonators and lighting the fuse. One boy held the detonator too long and lost three fingers. ....		1
Boy, age 17, working as a kitchen helper for a construction company, found a number of blasting caps. He threw them in a lighted oil burner where they exploded, causing the loss of an eye and three fingers from each hand. The other eye was also injured. ....		1

APPENDIX D—*Continued*PART II—*Continued*PLAYING WITH DETONATORS—*Concluded*

Cause of Accident	Killed	Injured
While housecleaning, a woman found some dynamite caps. She did not know what they were and gave them to her 9 year old son to play with. The boy struck them with a hammer and lost nearly all the fingers on both hands.....		1
A farmer carried a box of 100 detonators into the kitchen of his home to show to a group of persons, including his wife and three children. When he took the lid off the box an explosion followed, instantly killing the farmer and one boy, age 10, and causing injuries to five others.....	2	5
Girl, age 6, was killed when she bit a detonator she found on the floor. Her father had placed several detonators upon a shelf where he thought they would be out of reach of the children. One of the detonators had rolled off the shelf on to the floor.....	1	.....
Indian boy found a box in a warehouse containing what he thought was tangled wire but which contained electric blasting caps with long wires. While trying to pull out some of the wire, he set off the caps. In the explosion he lost his right hand.....		1
Boys, 14 and 16, found a detonator near where an oil exploration crew had been working. They took it home and attached it to an electric fence battery. In the explosion that followed one boy lost two fingers, had part of his hand mutilated and suffered injury to his eye. The other boy received cuts to the hands and face.....		2

APPENDIX D—*Continued*PART II—*Continued*

## PLAYING WITH OTHER EXPLOSIVES

23 Persons were Killed and 222 Injured

Cause of Accident	Killed	Injured
<i>Home-Made Explosives—</i>		
Boy, age 14, lost two fingers and a thumb when an explosion occurred while he and a chum were playing with a chemistry set.....		1
Boy, age 16, lost his left hand as a result of an explosion while he was experimenting with chemicals in his home.....		1
Two boys, age 18, were injured, one seriously when they attempted to make gunpowder from chemicals. The mixture exploded while they were grinding it in a metal cup.....		2
While constructing a home-made bomb, a boy 14, was seriously injured when it exploded. A piece of metal tube entered his chest.....		1
Home-made gunpowder, rammed into an iron pipe by two young men exploded when they tried to bore a hole in the pipe. Both suffered injuries to hands and eyes.....		2
Boy, age 14, made an explosive mixture and placed it in a lead pipe. The mixture exploded as he was sealing the end of the pipe. He lost three fingers.....		1
A 17 year old high school girl was killed and the teacher and two other pupils injured when a mixture of potassium chlorate and red phosphorus exploded during an experiment.....	1	3
Boy, age 14, lost part of his left hand when a "bomb" he was making, containing potassium chlorate and sulphur exploded.....		1
A 17 year old boy was fatally injured and a second boy hurt when a home-made cannon exploded.....	1	1
Boy, age 15, was making a Roman Candle. While he was forcing the powder into a cardboard tube, it fired, causing serious injuries to his hand.....		1
An amateur firecracker manufacturer, age 16, was injured when a batch of home-made firecrackers blew up.....		1
Boy, age 16, resident in a boarding school, took chemicals from the laboratory to his room to make gunpowder. The mixture exploded and he lost the sight of one eye.....		1
Two boys, 14 and 17, tried to make a rocket by placing pistol powder in a lead pipe and lighting it. The resulting explosion caused serious injuries to the two boys.....		2
<i>Firecrackers, Ammunition and Gunpowder—</i>		
A police officer lost a finger and thumb when a sky rocket exploded in his hand.....		1
A 20-year old youth was severely burned when he set a match to powder he collected from fireworks left over from a display.....		1
Boys were exploding cartridges with a hammer. A seven year old girl watching them was struck and suffered painful leg injury.....		1
Shot shells, thrown on a bonfire, exploded and caused injuries to a boy.....		1
Two boys, age 16 and 17, were injured by a bullet that exploded in the pocket of one of the boys.....		2
Boy, age 10, suffered serious injuries to his eyes when he placed a lighted match inside a can containing gunpowder.....		1
Boy, age 14, lost the sight of one eye when he threw .22 rifle shells into a fire.....		1
A woman was injured when a "torpedo" firecracker placed on a street car track exploded and struck her in the face.....		1
Four children were injured when a loaded shotgun, in the hands of their father, exploded while he was trying to remove the shell.....		4
Youth, age 19, suffered fatal injuries when struck on the side of the head by a sky rocket.....	1	
Boy, age 12, suffered burns when a companion lighted firecrackers in his pocket.....		1
Boy, age 14, was burned and fatally trampled, and several persons were injured when a box of sky-rockets exploded prematurely at a sports day's gathering.....	1	several
Boy, age 10, was injured when a railway torpedo he found exploded as he was playing with it.....		1

APPENDIX D—*Continued*PART II—*Continued*PLAYING WITH OTHER EXPLOSIVES—*Continued*

Cause of Accident	Killed	Injured
<i>Firecrackers, Ammunition and Gunpowder—Concluded</i>		
Two boys, age 15, were burned when they dropped a lighted match into a can containing gunpowder. ....		2
Boy, age 16, struck a rifle shell with a hammer, causing it to explode. He lost an eye. ....		1
Two boys, ages 12 and 13, put rifle cartridges in a bottle, stuffed it with paper and applied a match. The bottle exploded injuring both boys. ....		2
A man received a serious injury to his arm when he attempted to saw a rifle shell in half. ....		1
Boy, age 8, held a large firecracker in his hand and lighted it. He suffered serious burns to his face. ....		1
Boy, age 12, was seriously burned when a firecracker ignited in his pocket and set his clothes ablaze. ....		1
Boy, age 6, was killed and three persons seriously injured when a 20-pound can of gunpowder exploded. The children had been laying trails of powder on the ground and lighting them. ....	1	3
Girl, age 12, was badly burned when she held a lighted sparkler too close to a box of sky-rockets bought for a community display. ....		1
Boy, age 15, suffered head injuries when struck by exploding fireworks. ....		1
Boy, age 14, threw a .22 calibre rifle bullet in a bonfire at a boy scout camp. The bullet exploded and the boy received the full force of the explosion in his face causing the loss of his left eye. ....		1
Boy, age 14, received a serious eye injury when he placed a rifle bullet in a vise and struck it with a hammer. ....		1
A six year old girl was given a tubular shoelace which, she did not know, was filled with .32 calibre bullets. She stuck a cement step with it and the bullets exploded causing burns and facial injuries to the child. ....		1
<i>Military Explosives—</i>		
Youth, age 19, suffered serious burns when a phosphorous smoke bomb he found by the side of the road exploded in his pocket. ....		1
A garbage collector lost three fingers of his right hand when he was examining a flash bomb he found in the garbage. ....		1
Boy, age 9, was killed and his brother, age 14, injured playing with a three inch mortar shell found near a military range. ....	1	1
Two boys, age 10 and 12, were killed and their mother seriously injured when a mortar bomb the boys had found exploded in their home. ....	2	1
A young man struck a match on a "war souvenir" that had been in the house for months. It exploded and he lost a hand. ....		1
Boy, age 8, was given an anti-aircraft shell by an older boy. He struck it with a hammer and received serious injuries. ....		1
Two 16 year old boys were injured when a 2-inch mortar shell they found on a practice range exploded. One boy kicked it. ....		2
Two boys, age 11, were injured, one critically, when a hand grenade they found on a practice range exploded. ....		2
Boy, age 12, lost an eye and suffered severe injuries when he pulled the pin from a hand grenade he found in a military area. ....		1
A 15-year old boy lost both hands when a "souvenir" mortar bomb he was making into a lamp stand exploded. ....		1
A 6-year old boy and his grandmother were fatally injured when a 2-inch mortar bomb the boy had found on a training ground exploded when he struck it with a hammer. ....	2	
Boy, age 14, died from injuries received following the explosion of a 3-inch mortar bomb he found on an army range. ....	1	
Boy, age 13, lost a hand and an eye, and two companions were injured when a hand grenade they found on the bank of a river exploded. ....		3
A 14-year old boy was blown to pieces when he attempted to open a mortar bomb with a pair of pliers. ....	1	
A man lost his right hand, a finger of the left hand and suffered body lacerations and injuries to his right eye when he tampered with a mine fuze that had been washed up on the beach. ....		1
Boy, 14, found a military practice bomb. He broke it open and lit a match to the powder. It exploded, seriously injuring his face. ....		1

APPENDIX D—*Continued*PART II—*Continued*PLAYING WITH OTHER EXPLOSIVES—*Concluded*

Cause of Accident	Killed	Injured
<i>Military Explosives—Concluded</i>		
Boy, age 8, lost an eye and parts of three fingers when an apparently harmless souvenir gun shell exploded in his hands.....		1
Boy, age 13, was burned when he tried to light the powder from a magnesium flare he found near a military camp.....		1
Boy, age 11, was killed and two companions injured while they were collecting discarded hand grenades in a military practice field.....	1	2
A 19-year old war veteran brought a two-inch mortar bomb home as a souvenir. He dropped it on the sidewalk and it exploded, causing injuries from which he died.....	1	
Youth, age 18, lost his left leg, left eye and suffered injuries to his hands when he tampered with a mine fuze washed up on the beach.....		1
Boy, age 12, had one of his hands blown off when a war souvenir he was playing with exploded.....		1
A 12-year old girl picked up military ammunition that was washed up on the shore. She struck it with a rock, causing an explosion and was severely injured.....		1
A man attempted to cut a "souvenir" anti-aircraft shell with a blow torch, causing it to explode. He died from the injuries received.....	1	
Three boys died and one was seriously injured when they tampered with a mortar shell that they found while digging topsoil at an abandoned army firing range.....	3	1
Children found a hand grenade in a ditch near their home. When one of them, a 10-year old boy, was carrying it up the front steps of his home he fell and the grenade exploded. He was killed, two other children were seriously injured, and the house was wrecked.....	1	2
A 9-year old boy found a "thunderflash" on the street and took it home. He broke it in half and when he put a light to it, it exploded and caused him the loss of his left hand, serious facial injuries to his mother who was watching, and lesser injuries to his two brothers, 11 and 3.....		4

APPENDIX D—*Continued*PART II—*Concluded*

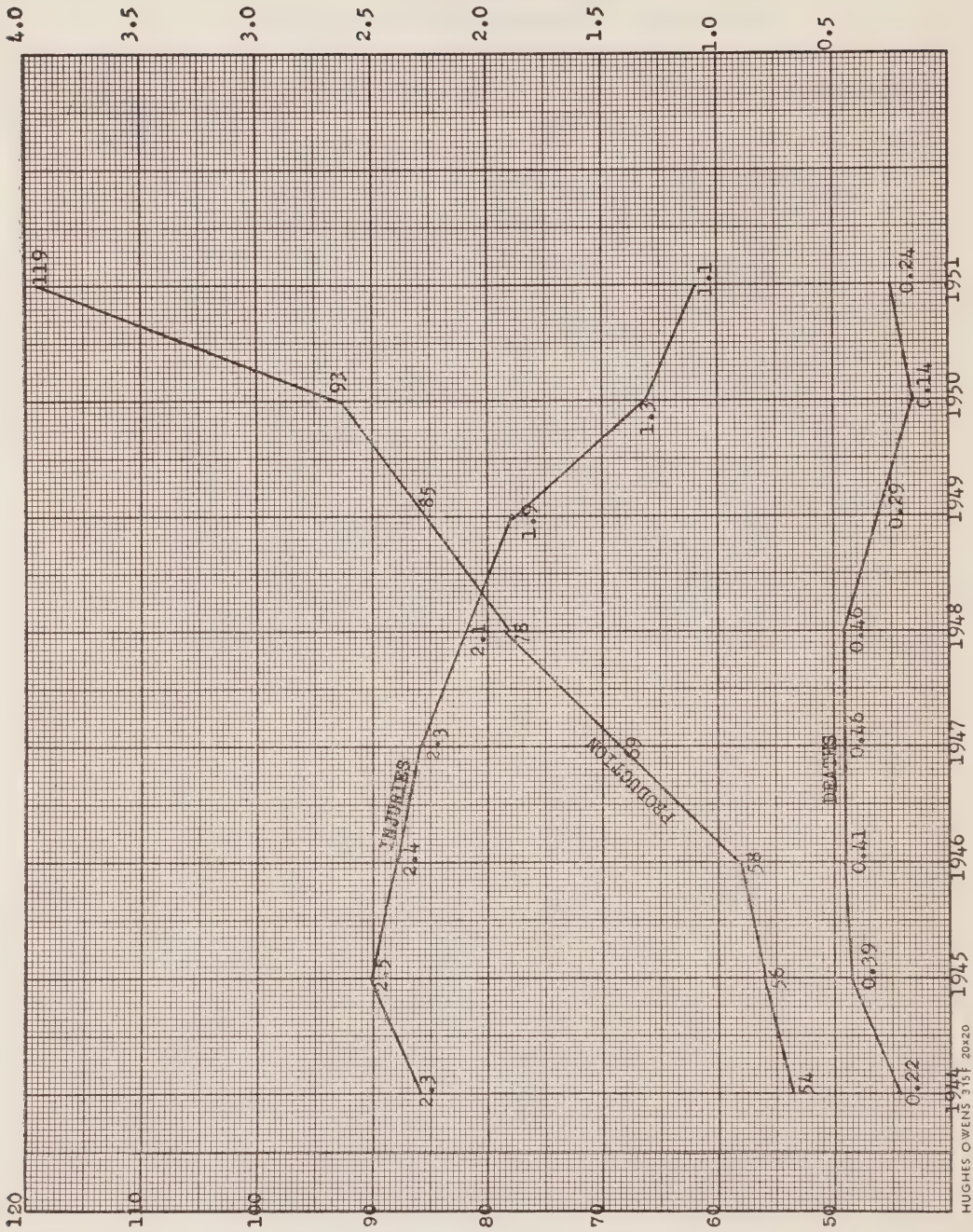
## MISCELLANEOUS

14 Persons were Killed and 51 Injured

Cause of Accident	Killed	Injured
A man was injured when he struck a track torpedo with a pick while digging near a railway storage shed.....		1
A 2-year old girl lost an eye and 14 other people were injured when a mortar flash bomb, fired from a float in a parade, exploded prematurely.....		15
A referee at a hockey game suffered an eye injury when a fan tossed a "thunderflash" on to the ice.....		1
A man was injured while he was welding an iron partition in a ship. The heat of his torch set off a shell—the presence of which he was unaware—that had fallen behind the partition.....		1
A farmer shot at a porcupine in a shed where dynamite was stored; an explosion followed which killed him.....	1	
A man was killed in a shed where he was working when a stick of dynamite stored in a coal pail exploded. Sparks from a nearby forge are believed to have set off the explosion.....	1	
A safe cracker was killed when nitroglycerine with which he was preparing to blast a safe exploded.....	1	
Boy, age 13, received serious head injuries when a blast in a nearby quarry caused him to fall.....		1
Two university students were injured when a chemical experiment they were working on blew up. One received serious eye injuries.....		2
One person was injured when a fireworks display at a fair was prematurely ignited by a wayward rocket.....		1
A young man at a construction camp was smoking near an open box of blasting caps when they exploded causing injuries to his arms, legs, chest and face.....		1

APPENDIX D—*Concluded*

## PART—III



YEARS 1944-51  
**Left margin, Production of Explosives in Millions of Pounds. Right margin, Deaths and Injuries (all causes) per Million Produced.**

## APPENDIX E

Accidents in the Manufacture of Military Explosives and Munitions  
1940-1945

	Killed	Injured
<i>Military High Explosives—</i>		
T.N.T.....	4	14
Tetryl.....	1	1
R.D.X.....	0	0
Nitroguanidine.....	5	18
<i>Propellants—</i>		
Cordite and Guncotton.....	7	19
Smokeless Powder and Nitrocotton.....	2	5
<i>Shell Filling—</i>		
Mortar Ammunition	1	12
Artillery		
Grenades		
Mines		
Bombs		
Torpedo War Heads		
Depth Charges		
<i>Initiators—</i>		
Lead Azide.....	2	10
Detonating Compositions (Mixing).....	2	14
Filling Detonators.....	2	129
Inspecting Detonators.....	1	4
Destroying Detonators.....	2	2
Primers.....	0	9
<i>Fuzes and Ammunition—</i>		
Fuzes.....	0	19
20 mm. S.A.A.....	0	10
.303 S.A.A.....	0	.....
Tracers.....	0	24
<i>Smoke—</i>		
Generators}	8	12
Bombs }		
<i>Military Pyrotechnics—</i>		
Flares	6	10
Tear Gas Bombs		
Rockets		
Very Signals		
Markers		
Practice Bombs		
<i>Waste Explosives.....</i>	0	8
	43	320

## APPENDIX F

## Authorized Explosives

Authorized Explosives manufactured by Canadian firms:

Canadian Industries Limited (Explosives Division)—

Ammonia Dynamite—20, 25, 30, 35, 40, 50 and 60 per cent.

Ammonia Dynamite quarrying—60 per cent.

BL-100 60 per cent.

Black Blasting Powder.

Black Sporting Powder.

Blastol—60 per cent.

BRX-7—75 per cent.

BRX-7 (D.N.T.)—75 per cent.

Cilgel—50 per cent.

Cilgel (D.N.T. or T.N.T.)—50 per cent.

Cordite—MD, MDT, W, WT, WM, WMT.

C-X-L Dynamite—Nos. 1, 2, 3 and 4.

C-X-L Gelatin—Nos. 1 and 2.

C-X-L-ite.

Di-Drill Gelatin—60 per cent.

Ditching Dynamite—50 per cent.

Ditching Dynamite (D.N.T.)—50 per cent.

Driftite—70 per cent.

Driftite (D.N.T. or T.N.T.)—70 per cent.

Dygel—75 per cent.

Dynamex (Diameters 1" to 1½" incl.)—40, 50, 60 and 70 per cent.

Dynamex (Diameters 1½" and over)—40, 50, 60 and 70 per cent.

Explosives BL-101

BL-102

BL-103

Forcite—30, 35, 40, 40 (Asbestos Corporation)

50, 60, 75, 75 (bagged) 80 and 90 per cent.

Forcite (Brainerd Series)—30, 40, 50, 60 and 75 per cent.

Forcite (D.N.T. or T.N.T. Series)—30, 35, 40, 40 (Asbestos Corp.)

50, 60, 75, 75 (bagged)

80 and 90 per cent.

Free Running Ammonia Dynamite—65 per cent.

Fuse Powders—30, 40, 44, 53, 57 and 65 seconds.

Gelatin Dough—90 per cent.

Gelignite—62 per cent.

Giant Gelatin—30, 35, 40, 50, 60, 75, 80 and 90 per cent.

Giant Gelatin (Brainerd Series)—40 and 60 per cent.

Giant Gelatin (D.N.T. or T.N.T. Series)—20, 25, 30, 35, 40, 50, 60, 75, 80 and 90 per cent.

Guhr Dynamite.

Guncotton.

Gunpowder.

Gypsumite "A", "B" and "C".

Hi-Velocity gelatin—60 per cent.

Liquid Nitroglycerine.

Lump-Kol Pellet Powder.

Nitrocotton.

Pellet Powder No. 2.

Polar Dynamite—20, 25, 30, 35, 40, 50 and 60 per cent.

Polar Dynamite (straight nitroglycerine series)—25, 30, 35, 40, 50 and 60 per cent.

Polar Monobel—Nos. 4, 6, 7, 10 and 14.

Polar Monobel, sheathed—Nos. 4, 7 and 10.

Polar Monobel, No. 11.

Polar Monobel X (EQ.S.).

Signal Bombs.

S.N.G.

"Special No. 1" Dynamite.

Stopeite—20, 25, 30, 35, 40, 50, 55 and 60 per cent.

Stumping Powder—20 per cent.

Submagel—60 and 75 per cent.

Trinitrotoluene.

Vibrex—60 per cent.

Canadian Safety Fuse Co., Ltd.

Safety fuse—"Beaver" Brand.

Safety fuse—"Black Clover" Brand.

Safety fuse—"Black Pacific" Brand.

APPENDIX F—*Continued*Authorized Explosives—*Continued*Canadian Safety Fuse Co., Ltd.—*Concluded*

Safety fuse—"Clover" Brand.  
 Safety fuse—"Crown" Brand.  
 Safety fuse—"Moose" Brand.  
 Safety fuse—"Pacific" Brand.  
 Safety fuse—"White Jacket" Brand.  
 Safety fuse—"Yellow Jacket" Brand.  
 Hot Wire Fuse Lighters.  
 Igniter Cord—"Thermalite" Brand. Types A and B.  
 Primacord—Bickford Detonating Fuse.

## Canadian Industries Limited (Ammunition Division).

Ammunition.  
 Detonators.  
 Dextrinated Lead Azide.  
 Fuse Igniting and Connecting device.  
 "Lead Salt".  
 Lead Styphnate (Normal).  
 Percussion Caps.  
 Railway Fusees.  
 Railway Torpedoes.  
 Styphnic Acid.  
 Tetrazene.

Authorized explosives manufactured by other than Canadian firms:

## Cardox Corporation, Chicago, Ill.

Cardox.  
 Cardox Heaters.

## Central Railway Signal Company, Boston, Mass.

Railway Torpedoes.

## E. I. Dupont de Nemours &amp; Company, Inc., Wilmington, Del.

Auxiliary Charges C. 63  
 Detonators.  
 Dupont Bulk Powder.  
 Dupont Pistol Powder No. 6.  
 Explosive Rivets.  
 Fulminate of Mercury.  
 High Temperature E. B. Caps, No. 6.  
 Improved Military Rifle Powders.  
 "Nitramon S".  
 "Nitramon S" Primers.  
 Nitrocellulose.  
 Nitrostarch.  
 Open hole Shaped Charges (R.D.X. or Pentolite).  
 Perforating Shaped Charges (R.D.X. or Pentolite).  
 P.E.T.N.  
 Pyro (ground smokeless) Powder.  
 R.D.X. Cord.  
 Smokeless Powders.  
 Sporting Rifle Powders.  
 Tetryl.  
 Waterproof Boosters C.66.

## Ellefsens Tendskruefabrikk, Stokke, Norway.

Time Fuses and Detonators for Whaling Guns.

## Ensign Bickford Company, Simsbury, Conn.

Primacord Bickford Fuse.  
 Ignitacord.

## Federal Laboratories, Pittsburgh, Pa.

Lachrymatory Cartridges.  
 Powder Loads.

## Charles Hellis &amp; Sons Ltd., London, England.

12 Gauge Shotgun Shells.

APPENDIX F—*Continued*Authorized Explosives—*Concluded*

- Hercules Powder Company, Wilmington, Del.  
 Detonators.  
 Gelatin Oil Well Explosive.  
 Nitrocellulose.  
 Smokeless Powders.  
 Vibro Caps.  
 Vibrogel B and 3.
- Illinois Powder Manufacturing Co., St. Louis, Mo.  
 Detonators, Gold Medal Oil Well Explosive, 100 per cent.
- Imperial Chemical Industries, Limited, England.  
 Cerium Low Tension Fuseheads.  
 Percussion Caps.
- Independent Eastern Torpedo Company, Findlay, O.  
 Nitroglycerine.
- Lake Erie Chemical Co., Cleveland, Ohio.  
 Lachrymatory Cartridges.
- Lane-Wells Co., Los Angeles, Cal.  
 Gun Perforator Cartridges.
- Mine Safety Appliances Co., Pittsburgh, Pa.  
 Stud Units for Velocity Power Driver.
- Olin Industries Inc., East Alton, Ill.  
 (Western Cartridge Co. Division)  
 Cyclonite.
- Pacific Railway Signal Co., Peru, Ind.  
 Railway Torpedoes.
- John R. Powell, Plymouth, Pa.  
 Miners' Safety Squibs.
- F. J. Roberts Squib Company, Punxsutawney, Pa.  
 Miners' Safety Squibs.
- Trojan Powder Company, Allentown, Pa.  
 Nitrostarch.
- Western Cartridge Company, East Alton, Ill.  
 Detonators.  
 Kiln Gun Shells.
- Winchester Arms Company, Cleveland, Ohio.  
 "Tempotool" Cartridges.

## Authorized Manufactured Fireworks

Fireworks Manufactured by the following Canadian makers are authorized:

- Atta Toys & Novelties, Toronto, Ont.  
 W. F. Bishop & Son Limited, Toronto, Ont.  
 Canadian Industries Limited.  
 Canadian Safety Fuse Company Limited, Brownsburg, P.Q.  
 Dominion Fireworks Co. Ltd., Dixie, Ont.  
 T. W. Hand Fireworks Co. Ltd., Cooksville, Ont.  
 Last Minute Manufacturing Company Limited, Thorold, Ont.  
 Macdonald Metals and Plastics Limited, Waterloo, Que.  
 Montreal Fireworks Displays Manufacturing Company, Ville St. Pierre, P.Q.

Certain fireworks manufactured outside of Canada by the following makers are authorized:—\*

- Acme Fireworks Corporation (Acme Novelty Manufacturing Company) River Grove, Ill.  
 Aerial Products Incorporated, Merrick, L.I., N.Y.  
 American Railway Signal Company, Fostoria, Ohio.  
 Anthes Force Oiler Company, Fort Madison, Iowa.  
 Atlas Fireworks Co., Inc., Los Angeles 22, Cal.  
 M. Backes & Sons Limited, Wallingford, Conn.  
 C. T. Brock & Co. Hemel Hempstead, Herts, England.  
 Central Railway Signal Company, Boston, Mass.  
 Columbia Manufacturing Co. Inc., Elkton, Maryland.  
 Continental Fireworks Manufacturing Co. Dunbar, Pa.

\* A list of authorized fireworks is on file in the office of the Explosives Division. Information may be obtained on request.

APPENDIX F—*Concluded*Authorized Manufactured Fireworks—*Concluded*

J. Halpern, Co., Pittsburgh, Pa., Distributors for Lenover Corporation, Chester, Pa., and Lenover, Pa.  
 Thos. Hammond & Company, Craigmillar, Edinburgh, Scotland.  
 Hudson Fireworks Display Company, Hudson, Ohio.  
 Hitt Fireworks Company Limited, Seattle, Wash.  
 Interstate Fireworks Company, Springfield, Mass.  
 Japan Fireworks Trading Company Ltd., Tokyo, Japan.  
 Kent Manufacturing Corporation, Chestertown, Md.  
 Kilgore Manufacturing Company, Westerville, Ohio.  
 Lakeside Railway Fusee Company, South Beloit, Ill.  
 Lenover Corporation, Chester, Pa., and Lenover, Pa. J. Halpern, Pittsburgh, Pa., Distributors.  
 Marutamaya Ogatsu Fireworks Co., Tokyo, Japan.  
 National Fireworks Incorporated, West Hanover, Mass.  
 Pacific Railway Signal Co., Peru, Ind.  
 Pyrowerk, Hamburg-Neugraben, Germany.  
 Red Flare Signal Company, Toledo, Ohio.  
 Reliance Snap Company, Bishop's Stortford, Herts, England.  
 Schermuly Pistol Rocket Apparatus Ltd., Newdigate, Surrey, England.  
 Standard Fireworks Limited, Huddersfield, England.  
 Standard Railway Fusee Corporation, Boonton, N.J.  
 Thearle-Duffield Fireworks, Incorporated, Chicago, Ill.  
 Twin City Fireworks Company, Buffalo, N.Y.  
 Unexcelled Manufacturing Company, New York.  
 United Fireworks Manufacturing Company, Dayton, Ohio, U.S.A.  
 Van Karner Chemical Arms Corporation, New York.  
 Joseph Wells & Sons Limited, Dartford, Kent, England.  
 Wunderkerzen-Werk Carl Fleming, Hamburg-Neugraben, Germany.

Chinese firecrackers with gunpowder composition, and not exceeding 4" in length and  $\frac{9}{16}$ " in diameter, and small Chinese fireworks, are authorized when found to function satisfactorily on examination at port of entry.









EDMOND CLOUTIER, C.M.G., O.A., D.S.P.  
QUEEN'S PRINTER AND CONTROLLER OF STATIONERY  
OTTAWA, 1953